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FOREST RESEARCH REPORT

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EVALUATION OF A DENIS-CIMAF TRH-150 BRUSH-CUTTER FOR SITE PREPARATION AND SITE CLEARING

INTRODUCTION

Concerns over the environmental impact and costs of the brush-rake and burn method of site preparation have led to the implementation of alternative methods which leave slash on-site. Trials involving some of these methods indicate there are viable alternatives in certain conditions (NSDLF,1991a&b).

Recently, brush-cutting heads have been mounted on excavators and used in site preparation and stand conversions (Cormier, 1991). This type of equipment is capable of shredding both standing material and felled slash. This report summarizes the results of a trial completed in September 1991 to determine the productivity and effectiveness of a Denis-Cimaf TRH-150 Brush-cutter.

The trial was a joint project involving Forestry Canada and Nova Scotia Department of Natural Resources. Funding for equipment rental was provided through the Canada/Nova Scotia Cooperation Agreement for Forestry Development, Technology Transfer Program.

SITE DESCRIPTIONS

Three sites, representing a range of site and slash conditions were chosen for the trial. The sites were located at Caribou, Pictou Co.; Kemptown, Colchester Co.; and Springhill, Cumberland Co. The first two locations were cutovers, whereas the third was an immature stand of hardwood.

The Caribou site was harvested with a two-grip Rottne processor in February of 1991. Sites harvested with this type of equipment have proven difficult to site prepare (other than brush-raking and burning) due to the mounding of slash created by the two-grip harvester and the accumulation of unmerchantable felled stems on site.

The Kemptown site was harvested in May, 1991 using a Kamatsu® 165A excavator fitted with a Tapio 600R single-grip felling head. There was less of a mounding effect at this site as a result of the single-grip head distributing

Canada

Nova Scotia

the slash fairly uniformly over the site.

At Springhill, the site supported a stand of low value hardwood approximately 3-5 metres in height (27,000 stems/ha) and scattered residual spruce trees 12 to 15 metres in height. The residual trees were not removed for this trial. The understorey consisted of softwood regeneration 1-2 metres in height.

METHODS

Equipment

The equipment used for the trial was a Denis-Cimaf TRH-150 horizontal-shaft brush-cutting head, mounted on a Komatsu 200 (123 h.p.) excavator (Figure 1). The felling head is equipped with 15 knives arranged along a rotating horizontal shaft. The rotation of the shaft turns the knives, which results in slash being shredded.

The 1136 kg head has a cutting width of 1.3 m. The excavator weighs approximately 19,550 kg and has a boom length of 8.84 m.

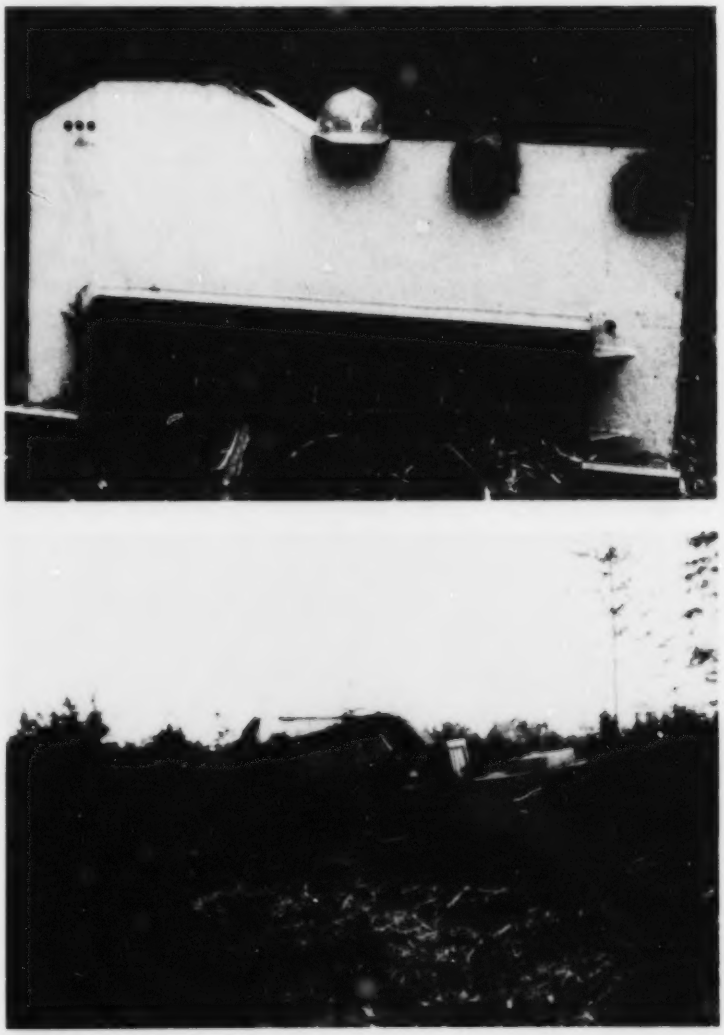

Figure 1. The Denis-Cimaf TRH-150 Brush-Cutter in site clearing.

The width of the excavator tracks are 0.81 m. The 1991 cost of the complete unit (brush-cutter and excavator) is about $235,000 or a charge-out rate of $117/scheduled machine hour[1] (Cormier, 1991). Appendix I shows the machine specifications.

Treatments

Prior to this trial, the operator had 200 hours experience clearing right-of-ways. To permit the operator time to develop an effective work technique, a 0.8 ha block at the Caribou site was set aside for training. During this period the operator experimented and received advice from field staff.

Site Preparation

A technique referred to as spot-shredding was developed. This technique involved positioning the cutting head on top of the slash piles, then moving it back and forth until it cut through the piles. Where the slash was not in piles the head was moved back and forth in front of the carrier, perpendicular to the direction of travel of the carrier until the material was shred to just above ground level. These methods were used at Caribou and Kemptown.

Site Clearing

At the Springhill location, the operator developed a "side to side" motion or approximately a 180 degree stroke during shredding. The boom was extended out in front of the machine and swung in an arc-like manner 90° to both sides. A shorter stroke, which involved moving the head between 45-60° to both sides (a total arc of 90-120°) was also used. For both methods, in order to completely shred the standing trees, it was necessary for the brush-cutter to make 2-3 passes over the same strip before moving forward.

Data Collection

Pre-treatment Assessment

At the Caribou and Kemptown sites, pre-treat-

1-includes cost of excavator and operator's wages.

Table 1. Pre-treatment site conditions at Caribou and Kemptown.

Conditions		Caribou	Kemptown
Previous Covertype		Softwood	Softwood
Drainage		Well Drained	Poorly Drained
Slope (%)		0-3	0
Stump Height (cm)		15-20	15-20
Surface Rock		Minimal	Minimal
Slash	Condition	Dry/slightly brittle	Dry/not brittle
	Load	Light-Moderate	Moderate-Heavy
	Distribution	Dense mounds with long unmerchantable stems	Uniform
Harvest	Date	February, 1991	May, 1991
	System	Random Length	Random Length
	Equipment	Harvester: Rottne	Harvester: Kamatsu®
	Felling Head	Rottne 2-grip	Tapio 1-grip

Rottne Snoken 860 : Rottne Logging Equipment
Kamatsu® 165A

ment data was collected by establishing plots at 20 metre intervals systematically over the site (Table 1). At each plot, assessments were performed to determine slash loading and distribution, slope, drainage, stump height and surface rock. At Springhill, data was only collected on stand conditions (density, height and species composition, Table 2).

Table 2. Pre-treatment site conditions at Springhill.

Location	Slope (%)	Drainage	Density (stems/ha)		Average Height (m)	
			Hwd	Swd	Hwd	Swd
Springhill	0-3	Good	25,700	1,370	3.9	2.6

Plantability assessments were also completed at each of the three sites. The assessments were performed by establishing lines systematically across each site and assessing the suitability of microsites for planting at 1.8 m intervals. Each assessment location was considered plantable if an acceptable microsite was found within ± 0.5 m of the preselected spacing of 1.8 m. Microsites considered not plantable for reasons other than slash were not included in the calculations. The basis for the calculations were:

$$\% \text{ Plantable} = \frac{\text{Plantable}}{\text{Plantable + Not Plantable}} \times 100$$

$$\% \text{ Not Plantable} = \frac{\text{Not Plantable}}{\text{Plantable + Not Plantable}} \times 100$$

where,

Plantable = total number of microsites rated plantable

Not Plantable = the number of microsites not plantable due to slash

An assessment was also performed to determine ease of access over the site. Access was classed as either difficult, moderate or easy depending on the quantity of slash impeding planter movement from one microsite to the next.

Post-treatment Assessments

Post-treatment assessments of plantability, access and site disturbance (rutting and mineral soil exposure) were conducted at each site following treatment using the same methods as for the pretreatment.

Time Studies

Continuous timing of both total and productive operating time, excluding time allotted for training and activity sampling, was undertaken. The continuous timing data was used to calculate machine productivity. Productive time was defined as the proportion of scheduled time that the shredder unit was engaged in site preparation. Productivity was determined by dividing the treated area in hectares by the productive machine hours (ha/PMH).

Activity sampling was performed by monitoring the machine at 20 second intervals for 1 hour periods. This provided information on the percent of time needed to carry out shredding activities.

RESULTS AND DISCUSSION

Treatments

Site preparation

The shredding treatment improved accessibility and created additional areas for planting by reducing the slash at each of the 3 sites. Treated slash was turned into slivers of bark (5-25 cm in length) and wood chips. The slash was distributed over the site as a result of the spinning action of the cutting knives. The post-treatment assessment indicated that at the Caribou site,

Table 3. Pre and post-treatment assessment of plantability and accessibility by location.

Location	Pre-treatment		Post-treatment	
	Plantable (%)	Access[1]	Plantable (%)	Access[1]
Caribou	69	Moderate	96	Easy - Mod
Kemptown	65	Difficult -Moderate	96	Easy
Springhill	NA[2]	Very Difficult	NA[2]	Easy

1 Accessibility : degree of difficulty in moving between assessment plots.
2 Site was covered with dense competition that was completely removed with the brush cutter.

plantability was increased from 69 to 96%, whereas at Kemptown the increase was from 65 to 96% (Table 3). Access was improved in both cases.

Site Clearing

At the Springhill site, the treatment resulted in a complete removal of all standing material. Stumps were cut to about 15-20 cm above ground level. The shredded material consisted of slivers of bark and wood strewn over the site. No further site preparation will be required before planting. The site will be monitored to assess the effect of the treatment on the regrowth of hardwood sprouts and suckers. Access was changed from difficult to easy.

Site Disturbance

Minimal site disturbance was observed on all three sites following treatment. Mineral soil exposure was minimized during shredding by careful placement of the cutting head.

Table 4. Area treated, productivity and productive time by location and method.

Location	Area Treated (ha)	Productivity (ha/PMH)	Productive Time (%)
Caribou	3.10	0.35	88
Kemptown	1.86	0.24	88
Springhill	2.36	0.20[1] 0.15[2]	83

1 180° swing of the boom.
2 90-120° swing of the boom.

Productivity Study

Productivity during site preparation varied from 0.24 ha/PMH at Kemptown to 0.35 ha/PMH at Caribou with an average of 0.29 ha/PMH (Table 4). Productivity was higher at Caribou, because only mounds of slash were shredded. At Kemptown, due to the broader distribution of the slash, more time was spent shredding. As a result, less ground was covered per unit time.

At the Springhill site, due to the uniformity of stand conditions, productivity was primarily determined by the cutting technique. When the head was moved in a full 180° swath, productivity was slightly higher (0.20 ha/PMH) than when the swing was 90-120° (0.15 ha/PMH). In completing a swath, 2-3 passes of the brush-cutter were usually required to shred all material to a 15 cm height. Although slope and surface

rock were not severe at the 3 trial sites, it is expected that productivity would be reduced where these conditions exist. No attempt was made to assess the influence of species on productivity.

Productive Machine Activities

The percentage of productive time dedicated to various shredding activities is shown in Table 5. Shredding was the most time consuming task at each of the sites, ranging from 65% at Caribou to 85% at Springhill. Less time was spent shredding on the cutover sites due to the time involved in moving between piles. This was also evident by the time involved in placement, 16% on the cutovers versus only 8% when working in standing material.

Table 5. The percentage of productive time required to perform each work activity by location and method.

	Caribou	Kemptown	Springhill	
			(90 – 120°)[1]	180°
Total Time Observed (hrs)	10.1	9.0	6.4	9.2
% Productive[2]	88	88	83	82
Activities[3]	**Percent (%)**			
Shredding	65	75	81	89
Moving	12	6	6	3
Placement	16	16	8	7
Turning	1	0	0	0
Non-productive	6	3	5	1
Totals	100	100	100	100

1 Movement of the boom.
2 Based on continuous timing of machine.
3 Activity sampling at 20 second intervals for 1 hour periods. Not all activities were recorded in each cycle.

Treatment Cost

The cost of this treatment was determined using the following variables:

A. Machine charge-out-rate : $117/PMH
B. Average Productivity
   1) Site preparation : 0.30 ha/PMH
   2) Site clearing : 0.20 ha/PMH

$$\text{Treatment Cost} = \frac{\text{Machine Cost}}{\text{Productivity}}$$

$$\text{1) Site preparation} = \frac{117}{0.30} = \$390/\text{ha}$$

$$\text{2) Site Clearing} = \frac{117}{0.20} = \$585/\text{ha}$$

SUMMARY

The major findings of trials undertaken to test a Denis-Cimaf TRH-150 brush-cutter used in site preparation and site clearing are as follows:

1. The Denis-Cimaf TRH-150 horizontal shaft brush-cutter was effective in site preparation and site clearing operations.
2. Based on a charge-out-rate of $117/scheduled machine hour (Cormier, 1991), the expected cost/ha of this treatment would be $390 for site preparation, and $585 for site clearing.
2. The percentage of plantable microsites on cutovers was increased to 96% and planter access was substantially improved.
3. Site preparation productivity on cutovers varied from 0.24 to 0.35 ha/PMH with an average of 0.30 ha/PMH. In site clearing, productivity varied from 0.15 to 0.20 ha/PMH depending on work technique (average : 0.18 ha/PMH).
4. In site preparation, productive activities accounted for 88% of work activities. On average, shredding accounted for 70% of the productive time, followed by placement of the head (16%), moving (10%) and turning (1%).
5. In site clearing, the shredder was capable of felling and shredding all material to just above ground level (15 cm). Following treatment the ground was covered with slivers of bark and wood.
6. In site clearing, on average, shredding accounted for 85% of productive time, followed by placement of the head (8%) and moving (5%).

LITERATURE CITED

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DISCLAIMER

This report is published for information purposes only. The exclusion of certain commercial products or services does not necessarily imply disapproval nor does the mention of other products or services necessarily, imply, endorsement by Forestry Canada or Nova Scotia Department of Natural Resources.

APPENDIX I
Specifications for the Denis-Cimaf TRH-150 Brush-Cutter[1]

Cutting Width (cm)	132
Weight (kg)	1136
Number of Knives	15
Flow Required (l/min)	100 -150
Hydraulic pressure (mpa)	28-34
Purchase Price ($)	235,000[2]
Hourly Cost ($/PMH)	117[3]

1 Information provided by Cormier, 1991.
2 Cost of excavator and Denis-Cimaf TRH-150 brush-cutter.
3 Includes operator wages.

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